REMARKS

This application has been reviewed in light of the Office Action dated November 12, 2009. Claims 1- 6 and 47-63 are presented for examination, of which Claim 6 is in independent form. Claim 6 has been amended to assure Applicants of a full measure of protection. Favorable reconsideration is respectfully requested.

Claims 6, and 47-63 were rejected under 35 U.S.C. 103(a) as being unpatentable over Lau et al. ("Field Emission from Metal-containing Amorphous Carbon composite Films", Diamond and Related Materials, Vo. 10, 1727-1731) in view of WO 99/28939 (*Tuck et al.*) and U.S. Patent 5,986,857 (*Hirano et al.*) and U.S. Patent 6,270,389 (*Kobayashi et al.*).

Independent Claim 6 recites:

> 6. An electron-emitting device comprising:
>
> a cathode electrode; and
>
> a layer connected to the cathode electrode, wherein
> a plurality of groups of particles, each group being constituted by at least two particles which comprise metal as a main component and are adjacent to each other, are discretely arranged apart from each other by a distance equal to an average film thickness of the layer or more in at least a surface and surface vicinity region of the layer, wherein the surface and surface vicinity region between the groups contain substantially no metal,
>
> the layer comprises as a main component a material which has resistivity higher than resistivity of the particles,
>
> the adjacent two particles are distinct crystalline particulates arranged to be separated from others in a range of 5 nm or less, or to be just in contact with another, and
>
> the size of the adjacent two particle in diameter are smaller than the average film thickness of the layer and one of the adjacent two particles is arranged to be nearer to the cathode electrode than the other particle.

Amended Claim 6 further clarifies a layer configuration and that adjacent two particles are distinct crystalline particulates arranged to be separated from another in a range of 5nm or less or to be just in contact with each other.

As described from page 52, line 20 to page 53, line 2 of the specification, dispersed metal elements in the carbon film are converted into particles through cohesion under the heat treatment and also the particles are localized into groups in each of which a plurality of particles exist. At least inherently, the particles formed through cohesion are distinct crystalline particulates arranged to be separated from others or to be just in contact with one another.

Page 24, lines 19-23 of the specification relates to distinct particulates and how they influence characteristics of the electron emission device. The resistance at individual electron emission sites is high, even if adjacent particles are in contact with each other (as well as a case where the adjacent particles are separated from another). Thus, it is surmised that an extreme increase in an emission existing layer 2 can be suppressed, and electron emission can be performed stably. (See e.g., lines 23 to 27 on page 24 of the specification).

Lau et al., page 1728, left column discloses as follows;

> "The filtered cathodic vacuum (FCVA) technique for depositing a-C:Me composite films has been discussed in detail elsewhere [11,12]. The Metal-coating graphite targets were made of metal and graphite powder of various (at.%) composition.
>
> . . .
>
> The micro-Raman results show that the sp^2 content increases with increasing metal content in the composite films [12]. By introducing metal, it is expected that more doubly bonded carbon clusters or even metal clusters may be created in the films at the expense of the number of the number of sp^3 bonds. The a-C:Me films were heat-treated in a program-controlled furnace with a base pressure of 10^{-3} torr."

However, Lau et al. does not disclose or suggest a plurality of groups (discretely arranged apart from each other by a distance equal to an average film thickness of the layer or more), each group being constituted by at least two crystalline metal particles. Instead, Lau et al. discloses that the heat-treated (a-C:Co, Al, Ti) composite is improved for the field emission properties. For the micro-structure of the heat treated a-C:Co, Lau et al. teaches that cobalt (metal) in amorphous carbon films can enhance the conversion of sp^3 to sp^2 during heat-treatment, with sp^2 bonded carbon clusters; such as carbon nano-grains and carbon nanotubes (see page 1728, right column). Although Lau et al. refers to "metal cluster", it does not teach or suggest metal crystalline particles in grouping for an electron emission site.

Kobayashi et al. teaches the dimension of the crystalline metal particle for an electron emission site (20 angstrums), but is not seen to teach or suggest anything that would remedy the above-noted deficiency of Lau et al. as a reference against Claim 6.

The Office Action notes that Tuck et al. discloses an analogous layer formed on a cathode of an emitter device. Referring to Figure 2b and to Tuck et al., however, particle 231 is <u>one piece</u> and cannot be regarded to be a group which contains at least two distinct particles. For fabrication of the structure of Fig. 2a or 2b, Tuck et al. teaches a flow coating process such as spin coating (Fig. 3), photoresist patterning (Fig. 4), and spraying (Fig. 5) to dispersively arrange particles 223 (Fig. 2a) or 231 (Fig. 2b) on the substrate. Considering these fabrication methods, it is clear that Tuck et al. fails to disclose a plurality of groups (each of group being constituted by at least two distinct particles) arranged discretely apart from each other by a distance equal to an average film thickness of the layer or more. In Tuck et al., since each of the particles 231 of Fig. 2b is a single piece, when the particles are metal, the resistance at the electron emitting site will be low. Accordingly, the structure of Fig. 2b of Tuck et al. does not effect the <u>high resistance</u>.

Hirano et al. is cited in the Office Action as teaching incorporating hydrogen into an amorphous carbon film in order to reduce internal stress, but is not seen to each or suggest anything that would remedy the above-noted deficiencies of Lau et al., Kobayashi et al., and Tuck et al., as references against Claim 6 herein.

For these reasons, Claim 6 is clearly patentable over Lau et al., Kobayashi et al., Tuck et al., and Hirano et al., whether considered separately or in combination.

The other claims depend from Claim 6, and also are believed to be clearly patentable for the same reasons as is that independent claim. Since each dependent claim is also deemed to recite an additional aspect of the invention, however, the individual consideration of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request early and favorable consideration and passage to issue of this application.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our address given below.

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